An Integration and Evaluation Framework for ESPC Coupled Models

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LONG-TERM GOALS

To realize its potential, a U.S. Earth system modeling and prediction capability must encompass a network of agencies and organizations that contribute model components, infrastructure, and scientific and technical expertise. The model component contributions must be integrated using coupling software, optimized as a whole, and the predictive skill of the resulting models assessed using standard metrics. We propose to provide these integrative functions for the Earth System Prediction Capability (ESPC), using as a reference application a version of the Community Earth System Model (CESM) running an optimized version of the HYbrid Coordinate Ocean Model (HYCOM).

We will establish a Coupling Testbed as a resource available to ESPC modelers, with Testbed leads who have developed infrastructure for major modeling systems and can engage and motivate interactions with modelers at NASA, NOAA, and other centers. The Testbed will be used to explore and prototype design and performance challenges related to integration, migrate optimizations to ESPC codes, and advance convergence of coupling interfaces to support knowledge transfer and controlled experimentation. We will work to broaden existing multi-agency computational working groups to address ESPC performance concerns and new application requirements.

We will advance and update a coupled CESM-HYCOM system prototyped under other funding with a version of HYCOM optimized for accelerator-based architectures. This HYCOM version will be obtained from a linked proposal, entitled Accelerated Prediction of the Polar Ice and Global Ocean. Performance of the ocean component is of particular interest because we choose to emphasize science applications that are of greatest interest to the Navy, and this is best done at ocean eddy resolving scales. The coupled system will be suitable for data assimilative prediction problems with timescales from one week to up to one year. The ESPC Coupling Testbed will be used to optimize the coupler and explore system-wide optimization strategies.

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OBJECTIVES

The objectives of our work are:

- To establish an ESPC Coupling Testbed that allows for collaborative research into coupling technologies, and use it to prototype multi-model optimization techniques focused on computing systems with accelerator technologies.
- To support migration of optimization strategies from the ESPC Coupling Testbed to infrastructure packages and coupled model applications, and provide support for coupling of optimized components in the ESPC program.
- To update a newly coupled CESM-HYCOM model configuration with an optimized version of HYCOM and assess the coupled system performance.
- To evaluate the CESM-HYCOM model using standard measures of predictive skill, and promote the usage of standard metrics by other models in the program.
- To extend ESPC-related computational committees to address new requirements driven by changes in computing architectures and program needs, and to initiate scientific committees.

APPROACH

We plan to evaluate the computational performance and predictive skill of the CESM-HYCOM code using standard metrics. In particular, we will perform a suite of numerical experiments examining how the model performs in simulating current climate at both moderate and ocean eddy resolving scales (e.g., Kirtman et al. 2012), and we will implement a set of retrospective forecasts taking advantage of the NMME protocol, again at both moderate and ocean eddy resolving scales. As part of the process, we will also be evaluating the coupled modeling system in more idealized configurations, but as above, the testing will be driven by physical science applications. The CESM-HYCOM evaluation proposed here is a hard-nosed assessment of how a core Navy model (HYCOM) performs in coupled and predictive mode. Moreover, the evaluation procedures follow metrics developed as part of the National Multi-Model Ensemble (NMME; Kirtman et al. 2013) project and standard climate diagnostic applied to CESM, so that this core Navy model can be easily compared to other models. Finally, as the Navy develops its own ESPC coupled model the proposed evaluation can be not only for comparison, but also as an approach to assess other Navy component models.

WORK COMPLETED

The project has just begun and only a small amount of funding has been received. Work compled includes the following: (i) We have ensured that our "control" code is up and running on GAEA and (ii) we have begun team telcons to ensure the efforts of the team is well coordinated.

RESULTS

No results to report at this time.

IMPACT/APPLICATIONS

Nothing to report at this time.

REFERENCES

Kirtman, B. P., and co-authors, 2012: Impact of ocean model resolution on CCSM climate simulations. *Climate Dynamics,* DOI 10.1007/s00382-012-1500-3.

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